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Influence of genetic and non-genetic factors on growth profile of Bharat Merino sheep in semi-arid region of Rajasthan

ASHISH CHOPRA[1], L L L PRINCE[1], G R GOWANE[1] and A L ARORA[2]

Central Sheep and Wool Research Institute, Avikanagar, via- Jaipur, Rajasthan 304 501 India

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Bharat Merino is a synthetic dual type fine wool and mutton sheep with 75% exotic inheritance, developed and maintained at Central Sheep and Wool Research Institute Avikanagar, Rajasthan. The purpose of this study was to quantify the effect of non-genetic factors such as year of birth, season and status of ewe at birth, in order to construct an operational model for the accurate estimation of genetic parameters and prediction of breeding values. Data, collected over a period of 28 years (1980–2007) were classified in 4 classes. The traits included in the analysis were birth weight (BWT), 3 month weight (3WT), 6 month weight (6WT), average daily gain from birth to 3 months (ADG1) and average daily gain from 3 to 6 months (ADG2) of 4,388 lambs pertaining to both sexes. Likewise data were also classified in 4 groups according to dam weight.

All the animals in this flock were kept under semi-intensive management system. The flock was a closed type where about 250 breedable females were maintained in the flock over the years. These animals were subject to selection mainly for weight at 6 months and first greasy fleece yield. Male to female ratio for breeding was around 1: 25. Regarding feeding, concentrate mixture was offered *ad-lib*. to suckling lambs from 15-day age till weaning (90 days). After about 3 weeks of age, lambs were sent for grazing in morning and evening. During post-weaning period in addition to 8–10 h grazing and dry fodder supplementation, 300 g concentrate mixture per head to weaner lambs was provided.

Since the subclass numbers were unequal and disproportionate the data were analyzed by the least squares procedure of fitting constants and using LSMLMW programme (Harvey 1990). The statistical model included period (four classes), season, sex, dam weight (four classes), interaction between period and sex, interaction between season and sex, interaction between period and season and interaction between period, season and sex as fixed effects and regression of ewe's age at lambing was taken as covariate.

Present address: [1]Scientists, [2]PS and Head, Division of Animal Genetics and Breeding (e mail: ashishshopra1234@gmail.com).

Duncan's multiple range tests was used for comparing sub-group means. Least squares means for BWT, 3WT, 6WT, ADG1 and ADG2 were 3.31±0.01 kg, 15.67±0.07 kg, 22.39±0.10 kg, 138±01 g and 77±01 g, respectively.

Lambing period

Data spread over 28 years was included in this study and classified in 4 periods. Effect of period was highly significant ($P<0.001$) for all the traits (Table1). Body weights and ADGs were significantly higher through out the period of study except during third period, i.e. from 1996 to 2001. Change in the feeding practices where zero supplementation was practised from 1996 onwards for few years might have resulted in down fall in the body weights of the animals. Decreasing trend in the rainfall and higher frequency of draught in last decades faced by this region might have also contributed toward low production performance. Variation in physical environmental conditions, feed and forage availability prevailing in different years could lead to significant period differences. Similar significant effect of year of lambing was also reported by Dixit *et al.* (2001) in Bharat Merino sheep, Sharma *et al.* (2003) in Marwari sheep, Nehra and Singh (2006) in Marwari sheep and Rao *et al.* (2004) in Nellore sheep.

Season of lambing

Spring born lambs were heavier than the autumn born lambs (Table 1). Spring season is being practised as a major season for lambing in the institute flock. Results indicate that practice of getting major crop in spring season should be continued further for getting heavier lambs. Due to higher exotic inheritance of this strain, extra care was taken to avoid external stress. Pregnant and lactating ewes of this period were compensated for dry matter requirement by supplementary feeding to protect animals from metabolic stress. Lambs were also provided green feed mainly Lucerne with stall feeding. This effect is continued in 3WT and 6WT also as a carry over maternal permanent environmental effect. Pre-weaning daily gain (ADG1) has non-significant effect

Table 1. Least squares mean along with standard error (SE) for growth traits of Bharat Merino lambs

Traits/factors	BWT (kg)	3WT (kg)	6WT (kg)	ADG1 (g)	ADG2 (g)
LSμ±SE	3.31±0.01 (4388)	15.67±0.07(3875)	22.39±0.10(3468)	138±01(3875)	77±01(3421)
Period	**	**	**	**	**
Up to 1989	3.44±0.03^{a}(759)	16.64±0.17^{a}(680)	22.80±0.24^{a}(591)	147±02$^{a\ b}$(680)	72±02^{a}(589)
1990 to 1995	3.38±0.02^{a}(1082)	16.64±0.12^{a}(984)	23.80 ±0.17 ^{b}(915)	148±01 ^{b}(984)	85±02^{c} (895)
1996 to 2001	3.31±0.02^{b}(1278)	13.36±0.13 ^{b}(1040)	20.01±0.19^{c}(963)	112±01^{c}(1040)	75±02^{ab} (950)
2002 to 2007	3.12±0.03^{c}(1269)	16.02±0.13^{c}(1171)	22.97±0.18^{a}(999)	144±01^{a}(1171)	78±02^{b} (987)
SSN	**	**	**	NS	**
1	3.46±0.01(3654)	15.82±0.05(3214)	23.00±0.08(2878)	138±01(3214)	82±02(2845)
2	3.16±0.02(734)	15.51±0.13(661)	21.78±0.18(590)	138±01(661)	72±01(576)
Sex	**	**	**	**	**
Male	3.40±0.02(2165)	16.16±0.10(1871)	23.53±0.14(1605)	143±01(1871)	86±01(1586)
Female	3.22±0.02(2223)	15.17±0.09(2004)	21.26±0.13(1863)	133±01 (2004)	68±01(1835)
Ewe weight at lambing	**	**	**	**	*
≤ 33 kg	3.01±0.02^{a}(1551)	13.94±0.10^{a} (1307)	20.52±0.15^{a} (1176)	122±01^{a} (1307)	74±01^{a} (1166)
33.01 to 37.0 kg	3.29±0.02^{b}(1256)	15.18±0.10 ^{b}(1123)	21.94±0.15 ^{b}(996)	133±01 ^{b} (1123)	76±01^{a}(980)
37.01 to 41.0 kg	3.43±0.02^{c}(818)	16.29±0.12^{c}(746)	22.91±0.17^{c}(678)	143±01^{c} (746)	78±02$^{a\ b}$(666)
≥ 41.01 kg	3.50±0.02^{d}(763)	17.26±0.13 ^{d} (699)	24.21±0.18 ^{d} (618)	154±01^{d} (699)	81±02^{b} (609)
Period*Sex	NS	NS	NS	NS	NS
Season*Sex	NS	NS	NS	NS	NS
Period*SSN	*	**	**	**	**
Period*SSN*Sex	NS	NS	NS	NS	NS
Regression of Damage	NS	**	**	**	NS

Numbers in parentheses indicates the number of animals, **(P≤0.01), *(P≤0.05), NS (nonsignificant).

of season of lambing. ADG1 is non-significant owing to intensive type feeding management up to 3 weeks of age during pre-weaning period (hence getting the similar environment) is being followed here in Avikanagar.

These results corroborated with the observations of Nehra and Singh (2006), Dixit *et al.* (2001) and Dey and Poonia (2005) whereas Singh *et al.* (1987) found autumn lambs were heavier than the spring born lambs and Sivakumar *et al.* (2005) found no effect of season of lambing. The lower body weight of autumn born lambs emphasized the need to provide supplementary feed and adequate management of these lambs, to protect them from the variance inducing factor.

Sex

The sex of the lamb was a significant (<0.01) source of variation in all the traits (Table1). The male lambs were significantly heavier than the female lambs at birth and this superiority of the male lambs increased with the advancement of age. Higher pre-weaning and post-weaning daily gain was also found in male lambs than females. Better pre-natal and post-natal growth of male lambs may be due to differences in their endocrine profile and in their culling level practised at different ages. These results were in agreement with Sharma *et al.* (2003), Rao *et al.* (2004), Dey and Poonia (2005) and Nehra and Singh (2006).

Dam weight at lambing

Weight of the dams at lambing was a highly significant source of variation in all the body weights (Table 1). The effect of dam weight was more on ADG1 than ADG 2. A clear cut increasing trend towards an increase in the body weights of the lambs with increase in the weight of the ewe at lambing was seen. Heavier dams gave birth to heavier lambs because of better nutrition and more uterine space provided by them for developing foetus. Weaning weight and ADG1 of these lambs were also observed to be significantly high. After weaning, these heavier lambs maintained their superiority in advanced age whereas their ADG 2 was significant only at P<0.05. Similar results were found by Dixit *et al.* (2001); Dey and Poonia (2005) and Nehra and Singh (2006).

Dam's age at lambing

Dam's age at lambing was a non-significant source of variation at the birth (Table 1). This indicates the avoidance of extreme ends in birth weight by nature to maintain the genetic variance in a trait under selection. Similar results were also reported by Negi *et al.* (1987) in Gaddi sheep and its crosses. Dam's age was highly significant (P<0.01) at 3WT and 6WT, may be because older dams have more milk production and good mothering ability. Dixit *et al.* (2001) reported effect of age of ewe at birth and post-weaning ADG less significant, whereas it was found to be highly significant on all other traits in Bharat Merino sheep which is similar finding to our study.

Interaction effects

Among the interaction of fixed effect studied, only interaction between period and season had significant effect on birth weight (P<0.05) (Table 1). This indicated the constancy of seasonal variation under the study period which was always high. Interaction between period and season, interaction between season and sex, and interaction between period, season and sex were non-significant. Contrary to our study, the interaction between sex and year of birth was observed to be highly significant by Sharma *et al.* (2003).

Results clearly indicate that all the effects taken in study were either highly or moderately significant sources of variation on the growth traits. These findings demonstrate the need of giving proper attention to the significant factors and requirement of efficient flock management to obtain the optimum productivity. To obtain the more accurate estimates of genetic parameters and breeding values it is necessary to adjust the growth records for significant factors prior to further analysis.

SUMMARY

Present study was conducted to assess the effect of non-genetic factors on growth traits of Bharat Merino sheep. Effect of period was significant for all the traits. Season was significant for all the traits except ADG1 indicating uniform management during pre-weaning stage. Heavier dams gave birth to heavier lambs because of better nutrition and more uterine space provided by them for developing foetus. Dam's age at lambing was a non-significant source of variation at the birth, indicating the avoidance of very high and very low weight at birth by nature. Interactions were mostly non-significant except the interaction between period and season.

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